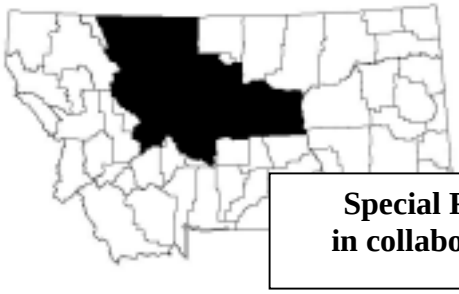
Westslope Cutthroat Trout
(Oncorhynchus clarki lewisi)
In Northcentral Montana

Status
and
Restoration Strategies

September 2000



Special Report by Montana Fish, Wildlife and Parks
in collaboration with Lewis and Clark National Forest

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Executive Summary

The Westslope Cutthroat trout (WCT) probably crossed the Continental Divide during the last ice age and colonized the upper Missouri River drainage about 10,000 years ago. WCT were likely the only trout in over 4000 stream and river miles in northcentral Montana when first described by Lewis and Clark in 1805. Pure WCT are now confined to about 5% of their historical range and are found in only about 200 miles of small headwater streams in northcentral Montana. "Secure" populations of pure WCT probably exist in only 1% of the original habitat in this area. There are about 70 unique populations in this area. Most of these populations are found in isolated stream reaches less than 5 miles long on federal lands and have a high risk of extinction due to their small habitat and population size. WCT appear to have experienced an abrupt and drastic decline early in the twentieth century. This decline coincided with the stocking of non-native rainbow trout, brook trout and brown trout. By the 1950's, these non-native salmonids had colonized most of the cold-water fish habitat in the Missouri drainage and WCT were confined to a few headwater populations. Most of these streams no longer contain native WCT because of competition with brook trout and hybridization with rainbow trout. Over-fishing and habitat loss due to mining, irrigation, grazing and logging probably also contributed to their decline.

This report summarizes WCT activities for each drainage in Region 4. Restoration efforts began in the 1970's and have intensified in the last 10 years. These efforts have included moving WCT to fishless headwater reaches to expand habitat, chemical treatment to remove introduced trout species and building barriers to prevent invasion from downstream non-native trout. Stocking pure WCT into fishless headwater areas is believed to have little effect on native amphibian and insect fauna and could potentially increase the number of river miles occupied by an additional 25%. Relocations in the last 10 years have already increased the number of river miles occupied by about 10%. With the help of a steering committee formed in 1996, the State of Montana has developed a statewide WCT Conservation Agreement, which has been signed by several state and federal agencies as well as some non-government organizations. A WCT Technical Committee was created in 1994 to assist in restoration efforts. Tentative plans are to maintain all existing WCT populations and to expand the current WCT distribution by as much as a few hundred miles in northcentral Montana. It is doubtful that WCT will ever have secure habitat in more than 10 – 20% of their original range in northcentral Montana. In some cases, it will be necessary to use fish toxicants such as rotenone and antimycin to remove non-native trout species and establish self-sustaining WCT populations as was done on Elkhorn Creek (Beartooth Game Range) in the 1970's. Future restoration activities will generally be in headwater reaches of mountainous areas and will go through the public review process. These activities should have limited effects on fishing for non-native trout and will increase opportunities for fishing for native cutthroat. Additional staff and resources will be needed to make timely progress on large-scale WCT restoration.

Overview

Background

Cutthroat trout are the Montana State Fish. The westslope cutthroat trout (WCT) is one of two subspecies of cutthroat trout found in Montana and is a species of special concern. WCT was essentially the only native trout species in the Missouri River drainage east of the Continental Divide. The need for WCT conservation is well recognized in Montana and the decline of the WCT has been well documented (e.g. Shepard et al. 1997b, McIntyre and Rieman 1995). In recent years an interagency WCT Technical Committee and a broad-based steering committee have worked to develop guidelines for WCT conservation. WCT have been a species of Special Concern since 1979 due to a documented decline in distribution and abundance on both sides of the Continental Divide. The species was petitioned for federal listing as a threatened species in 1997. In April, 2000 the U. S. Fish and Wildlife Service determined that listing was not warranted. The Service recognized that WCT have declined in the Missouri drainage but found that listing as a federal threatened species was not necessary because viable self-sustaining stocks are present throughout the range of WCT and many existing populations are protected by their location on roadless federal lands (USFWS 1999).

This document summarizes the status, restoration efforts and strategies for implementation of WCT restoration for each drainage in Montana Fish, Wildlife and Parks (MFWP), Region 4. Region 4 includes most of northcentral Montana including all of the Lewis and Clark National Forest and some of the Helena National Forest. The region includes the Missouri River and most of its tributaries from Canyon Ferry Dam downstream to the Musselshell River. Major tributaries include the Dearborn, Smith, Sun, Belt, Teton, Two Medicine, Judith and Musselshell drainages.

This report lays the foundation for WCT recovery and describes specific actions that could protect and enhance WCT populations. However, it will be necessary to develop basin-wide management plans with state, federal and local input to build a complete blueprint for recovery efforts. Basin plans are necessary to evaluate specific land-use impacts and consider site-specific restoration strategies such as fencing and bank stabilization that could benefit remnant WCT populations. Among other actions, these plans will determine the importance of slightly hybridized populations and determine which WCT populations can sustain harvest. Additional inventory and monitoring are needed before basin planning can be fully implemented. Many small headwater tributary streams have not been well surveyed for WCT and very few streams have a genetic sample size of at least 25 that is recommended for management purposes (Oswald et al. 1995). Future projects on specific streams will be analyzed individually and follow standard Montana Environmental Policy Act (MEPA) or National Environmental Policy Act (NEPA) procedures.

Distribution and History

WCT are found in Alberta, Idaho, Washington and Montana. They occupy the Upper Missouri east of the Continental Divide and the Upper Columbia River basin west of the divide as far south as the Clearwater and Salmon Rivers of Idaho (Behnke 1992). Cutthroat trout entered central Montana about 10,000 years ago during the last ice age when glacial processes allowed transfer of trout populations across the Continental Divide. Huge glacial lakes such as Lake Great Falls allowed cutthroat trout populations to flourish and populate numerous drainages (Roscoe 1987). Two subspecies of cutthroat trout are recognized in Montana, Yellowstone cutthroat trout that are native to the Yellowstone drainage, and WCT which are native to the Missouri, the Saskatchewan, and all major drainages west of the divide. Prior to the 1970's, Yellowstone cutthroat and WCT were considered to be the same species (Behnke 1992). Protein analysis has found that WCT are genetically distinct from Yellowstone cutthroat trout and are actually more similar to rainbow trout than they are to Yellowstone cutthroat trout (Allendorf and Leary 1988).

Historical records from the 1800's indicate WCT occupied most of the streams in central Montana. Lewis and Clark described WCT near Great Falls in 1805. Three to 4 pound trout (assumed to be WCT) were found in the Lewistown area in 1878 (Messiter 1890). Existing WCT distribution also indicates they occupied the Missouri River and its tributaries upstream of the Musselshell. The Musselshell is often considered part of the historical range of WCT, however the Castle News reported (1888) that the Upper Musselshell did not contain trout and no pure WCT have been found in the upper headwaters of the Musselshell. WCT may be native in the mid-Musselshell drainage however, since pure WCT populations have been found in the Flatwillow and Box Elder Creek drainages.

Figures 1, 2 and 3 show the current distribution of WCT, brook trout and rainbow trout in northcentral Montana. WCT distribution is based on Forest Service and MFWP Region 4 data files. Rainbow trout and brook trout distribution is based on data from the Montana River Information System. With the exception of the upper Musselshell drainage and the Sun River above Diversion Dam, we assume that most streams currently occupied by brook trout and rainbow trout in northcentral Montana were occupied by WCT. Brown trout distribution is not evaluated in this report because their habitat overlaps that of rainbow trout and brook trout and the large stream habitat brown trout occupy is unlikely to be affected during WCT restoration efforts in northcentral Montana.

There are only about 72 known genetically pure WCT populations remaining in northcentral Montana (Table 1). These populations occupy about 200 miles of habitat. Consequently, pure WCT are found in only about 5% of their native range of about 4000 stream miles in this area. An additional 168 miles (4%) is occupied by 39 populations of slightly hybridized WCT (Table 1). For comparison, brook trout and rainbow trout are each found in over 3000 miles of stream in northcentral Montana (Table 1, Figures 2 and 3).

Table 1. Existing distribution of WCT, rainbow trout and brook trout in central Montana (August 2000).

Drainage	Estimated miles of suitable historic habitat for WCT[1]	Miles of stream occupied by 100% pure WCT (# of pops.) [2]	Miles of stream occupied by 90-99.9% pure WCT (# of pops.)[2]	Miles of stream occupied by less than 90% pure WCT (# of pops.)[3]	Miles of stream occupied by brook trout[4]	Miles of stream occupied by rainbow trout[4]	Total stream miles in drainage[5]
Upper Missouri	1199	20 (5)	3 (1)	8 (2)	802	992	2200
Shonkin	21	0	0	0	21	14	
Highwood	55	3 (2)	0	0	55	44	
Smith	741	20 (8)	25 (5)	28 (6)	691	516	2858
Sun	365		9 (6)	5(1)	362	461	2404
Belt	249	56 (25)	40 (7)	10 (4)	211	197	800
Teton	335	10 (6)	21 (5)		329	194	1751
Two Medicine	267	42 (11)	34 (8)	9 (2)	240	194	1422
Cutbank Cr.	23	0	0		0	23	1089
Marias	150	0	0	0	0	150	2494
Arrow	47	3 (2)			47	34	1336
Judith	480	33 (11)	36 (7)	8 (2)	304	409	3223
Upper Musselshell					262	198	4676
Box Elder	94	2 (1)			0	94	891
Flatwillow	122	5 (1)			122	98	1372
Total Region 4	4313	202 (72)	168 (39)	68 (17)	3446	3468	26516
Total Region 3	5626	400[6]	116[6]	?	3804	3078	21136

[1] suitable habitat based on current rainbow and brook trout distribution in the historical WCT range (Steve Carson, MFWP, Montana Rivers Information System)

[2] calculated from USFS and MFWP data files. Number of populations may vary slightly due to questions about where one population ends and another begins

[3] genetically tested populations, 100's of more miles likely exist that have not been tested;

[4] miles from Montana Rivers Information System (Steve Carson, MFWP) and includes areas that were likely not historic habitat

[5] total drainage miles from Conservation Agreement (MFWP 1999), this number includes stream reaches that have not been surveyed, including areas that will not support trout

[6] from USFWS 1999

For the entire upper Missouri, including the headwaters in southwestern Montana, Shepard et al. (1997b) estimated that pure native WCT are found in only 5 – 13% of their original native range. Today the Missouri headwaters have about 5600 miles of known trout habitat (Table 1). That means that about 40% of the existing trout habitat in the Missouri drainage is in northcentral Montana. About 55% of the stream miles for the entire Missouri River basin are located in northcentral Montana. In Montana, there are far more WCT populations in the Columbia drainage west of the Continental Divide, where pure WCT are found in about 2000 miles of stream. Some areas west of the divide still have migratory WCT populations as well as the small resident populations typical east of the Continental Divide.

Generally, the decline of WCT appears to have been quick and drastic and coincided with extensive stocking of non-native trout species. Rainbow trout, brook trout and brown trout were first stocked in Montana in the 1890's (Hanzel 1959). Stocking records indicate that rainbow trout and brook trout were widely stocked throughout central Montana after 1928. Earlier stocking records are incomplete, but Fish and Game Commission Reports indicate stocking was widespread in northcentral Montana during the first quarter of the twentieth century. Yellowstone cutthroat trout were also widely stocked throughout the native WCT range (Behnke 1992). Displacement and hybridization occurred so rapidly that pure WCT were already limited to a few headwater populations by the 1950's (Hanzel 1959). Hanzel (1959) documented how quickly rainbow trout colonized one WCT stream; it took just three years, from 1955 to 1958, for rainbow trout to replace WCT as the dominate trout above a major falls on Tenderfoot Creek in the Smith drainage.

The decline of the WCT is continuing. For example, Hanzel (1959) found exclusively cutthroat trout in Rock Creek (Smith drainage) and West Fork of Lost Fork Judith where only remnant (if any) WCT populations remain in 2000. WCT have nearly disappeared from Deadman Creek (Smith River) within the past ten years. All of these streams now have extensive brook trout populations. Today the non-native trout threat comes primarily from hybridization with rainbow trout and competition with brook trout. Shepard et al. (1997b) modeled viability of 144 existing WCT populations in the Upper Missouri River and found that 71% had a very high risk of extinction within the next 100 years. The model found grazing and presence of non-native trout had the most influence on WCT populations while angling and mineral development were also important.

Most WCT populations in northcentral Montana are in Lewis and Clark National Forest streams but the Helena National Forest has about 7 populations located in the Upper Missouri and the Big Belt Mountains. Some populations on federal land extend downstream to private land. Only about five populations are known to be located primarily on private land while one population is located on U. S. Bureau of Land Management land and two populations are in streams on State of Montana Wildlife Management areas.

Viability of Existing Populations

Hilderbrand and Kershner (2000) estimate that 2500 individuals are necessary to maintain cutthroat trout populations over the long term and reduce extinction risk from catastrophic events. They claim that five miles of excellent of habitat with high densities of WCT or 15 miles of marginal habitat are needed to sustain that many fish. The vast majority of pure WCT populations in northcentral Montana are small remnant populations protected by barriers. Only about 14 WCT populations (at least 90% pure) in northcentral Montana occupy more than 5 miles of habitat. Several of these populations have low abundance due to poor habitat or presence of non-natives, or are accessible to rainbow trout. Probably less than 10% of the remaining pure WCT populations, occupying a total of

about 50 stream miles, contain 2500 individuals in northcentral Montana. Consequently, pure WCT are only "secure" in about 1% of their original range in this area. Only a handful of populations including, North Badger Creek (Two Medicine), Elkhorn Creek (Upper Missouri), Three Mile Creek (Upper Missouri), Halfmoon Creek (Flatwillow) and the recently established Upper South Fork Dupuyer Creek population (Two Medicine), have at least five miles of continuous habitat that are protected from non-native trout. Only one, North Badger Creek, is more than 15 miles long. However, many populations in northcentral Montana have remained viable for decades with less than two miles of habitat.

Restoration Efforts

Restoration efforts in northcentral Montana began in the early 1970's when a WCT population in Elkhorn Creek (tributary to Holter Reservoir) was preserved by using chemical removal of non-native trout above a constructed barrier. WCT were also moved from the Highwood Mountains to a fishless reach of Birch Creek in the Two Medicine drainage in the 1970's. In the last decade WCT restoration efforts have intensified in streams to protect threatened WCT populations. These efforts have included: 1) movement of WCT into about 10 miles of suitable habitat in fishless areas on three streams; 2) extensive fish population and genetics surveys; 3) construction of a temporary barrier on Chamberlain Creek and 4) brook trout removal by electrofishing. Tissue samples for genetic analyses have been taken from more than 1000 fish in about 130 populations since 1980. In addition, more than 18,000 fish have been captured from hundreds of populations during fish surveys over the past 6 years. Barrier construction is planned on Cottonwood Creek (Arrow Creek Drainage) and Cottonwood Creek (Upper Missouri) in the next 1 – 2 years and several other barrier sites are in the evaluation stages. Other on-going projects include proposed rehabilitation of Hound Creek and Middle Creek Reservoirs in the Smith River drainage.

Restoration Goals

Montana has taken a proactive approach to WCT restoration since the mid-1990's when a technical committee (1994) of fish biologists and a steering committee (1996) representing a wide variety of state and federal government agencies and non-government organizations were established. The collaboration of members of these groups resulted in the completion of a Conservation Agreement for WCT in Montana, which was signed in 1999. According to the Conservation Agreement, the management goal is to ensure the long-term, self-sustaining persistence of the subspecies within each of the five major river drainages they historically inhabited in Montana (Clark Fork, Kootenai, Flathead, upper Missouri, and Saskatchewan), and to maintain the genetic diversity and life history strategies represented by the remaining local populations.

The Agreement listed 5 objectives to obtain the management goal:

1) Protect all genetically pure WCT populations
2) Protect all introgressed (less than 10% introgressed) populations
3) Ensure the long-term persistence of WCT within their native range
4) Provide technical information, administrative assistance and financial resources to assure compliance with the listed objectives and encourage conservation of WCT.
5) Design and implement an effective monitoring program by the year 2002 to document persistence and demonstrate progress towards goal.

The agreement also specifies at least four geographically separate interconnected pure WCT populations must be established in the Missouri drainage. Each of these populations should occupy at least 50 miles of connected habitat. In northcentral Montana, the Conservation Agreement specifies one such population along the East Front (Sun, Teton or Marias drainages) and one population in the "Southern Tributaries" (Smith, Belt or Judith drainages). The Conservation Agreement acknowledges it may not always be possible to achieve 50 miles of connected habitat and provides some flexibility for such instances. In northcentral Montana we will undertake three strategies for WCT conservation. 1) Preserve all existing pure populations; 2) attempt to create two large populations as proposed in the conservation agreement; and 3) we recommend, in addition to the two large-scale populations, establishing 2 – 4 additional secure viable populations (minimum of 2500 individuals) each, in the Southern Tributaries and the East Front. Protection status of individual 90 – 99.9% pure populations will be further evaluated in drainage management plans for their role in WCT restoration. However, there are so few populations of WCT in northcentral Montana we tentatively plan to preserve most and perhaps all of the existing populations that are 90 – 99.9% pure.

Restoration Strategies

Removal of Non-native Trout

Long-term trout community observations in several watersheds in the Missouri drainage clearly show two of the most important causes for the decline of native WCT are replacement by brook trout and hybridization with rainbow trout. Consequently, pure WCT populations in this area can only be considered secure if they are isolated from competing non-native trout species. Successful long-term restoration of WCT will undoubtedly require removal of brook trout and rainbow trout from some streams since these species now occupy approximately 95% of the original WCT habitat. Brook trout will also be removed by electrofishing in some areas as a temporary measure to prevent extinction of WCT populations until long-term protection can be implemented. Electrofishing removal of brook trout in Chamberlain Creek (Belt Creek drainage) has resulted in at least a temporary increase in the WCT population. Even intense electrofishing removal of brook trout has not been successful for eliminating brook trout in streams (Thompson and Rahel 1996). However, Kulp and Moore (2000) found that intense electrofishing over a two-year period using AC current did eliminate rainbow trout in a small 10-foot wide stream. During removal efforts, WCT would need to be placed in protected areas prior to using AC current. It may be worthwhile to attempt to use electrofishing for permanent removal of brook trout in extremely small streams where fish toxicants can not be used. Such streams would probably need to have simple habitat and be less than 15 feet wide. For example, the presence of beaver dam complexes would limit opportunities for electrofishing removal. However, it is unlikely electrofishing will be an effective tool to re-establish long-term viable WCT populations because these small streams typically do not have enough habitat to support a population of at least 2500 individuals. Chemical fish removal using rotenone or antimycin has been controversial but when used correctly, is the only known way (except total dewatering, which is often not feasible) to eradicate unwanted fish in a safe manner. Rotenone was used successfully in 1972 to restore WCT in Elkhorn Creek, one of the few WCT populations with more than 2500 fish in northcentral Montana. It will be difficult to add additional populations of self-sustaining WCT in northcentral Montana unless chemical fish removal is used and controversies concerning its use are resolved.

Headwater Transfers

The only way to increase the amount of WCT without non-native trout removal is to expand into previously fishless headwater reaches above natural barriers. There are numerous opportunities for these upstream transfers along the Rocky Mountain Front where, a total of over 40 miles of fishless habitat in about 8 different streams is available. There are probably less than 15 miles of known fishless reaches elsewhere in northcentral Montana. About one quarter of the upstream transfer sites would support 2500 individual WCT. However, if WCT were transferred to all available fishless reaches, habitat occupied by pure WCT would increase by nearly 25%.

Barrier Construction

An important WCT restoration strategy is construction and installation of fish barriers to isolate WCT from non-native trout. Barriers are not without risks, since they can fragment and disconnect seasonal habitat for WCT and prevent them from accessing habitat above the barrier. They can also reduce the possibility that accessible habitat can support 2500 fish. However, barriers are the reason that most pure WCT populations still exist in northcentral Montana and additional man-made barriers will benefit WCT by reducing the possibility of competition and/or hybridization of WCT with non-native trout species. Little gene flow appears to have occurred even between connected populations across the entire range of WCT (Leary and Kanda 1997). Since many WCT populations have remained viable for decades in less than 2 miles of habitat, we view connected habitat as much less of an immediate concern than protecting the remaining pure WCT populations from hybridization with rainbow trout and/or competition with brook trout. Therefore, barriers will be built to prevent non-native trout from migrating upstream into WCT habitat. Some individual WCT will move below the barrier and be lost from that population. The risks of barrier construction versus no action will be considered prior to building a barrier. Threats of non-native trout to the WCT population will be considered as well as the amount of spawning habitat, pool habitat and winter flows above the barrier. If catastrophic events such as fire, flood, or extreme drought result in the extinction of a small resident population, biologists could move WCT from elsewhere to re-establish a population.

Connected Habitat

Connected habitat is important to refound populations after localized extinction from major events such as drought, flooding, fire and climatic change. The importance of large areas of connected WCT habitat is highlighted in the Conservation Agreement, which specifically calls for several areas of at least 50 miles of connected pure WCT habitat, with two such areas to be located in northcentral Montana. In almost all cases, interconnected populations will be extremely difficult to create in this area. However, it is important to keep our options open by preserving existing pure populations and WCT habitat to allow for future reconnecting of WCT populations if additional resources or improved techniques become available. With a few exceptions, like North Badger Creek, natural re-establishment of extinct populations by migrant WCT is currently impossible in northcentral Montana because existing WCT populations are very isolated. It will be very difficult to create 50 miles of connected pure WCT habitat in this area. The best prospect may be the North Badger drainage but it has only about 30 miles of interconnected habitat. In most cases, large-scale chemical removal of existing non-native wild trout populations will be necessary to create populations of over 2500 individuals or to create at least 30 miles of WCT habitat that is protected from non-native trout. Several of the best possibilities for creating large areas of habitat currently contain slightly hybridized

WCT populations. In such cases it will be necessary to decide whether to allow a small degree of hybridization or to remove all fish and re-establish a pure WCT population.

Replicating Existing Populations

One objective of the WCT Conservation Agreement is to protect all existing populations. Most populations have a high likelihood of extinction in the next 100 years (Shepard et al. 1997b). Many populations in northcentral Montana have less than 3 miles of habitat and contain far less than 2500 individuals. Duplication of these pure populations by fish transfers to either fishless headwater reaches or to stream reaches that have undergone chemical treatment for trout removal will reduce the extinction risk for each replicated population. Replicating individual populations will also help maintain genetic diversity of WCT, since the genetic structure of each population is unique (Leary and Kanda 1997). To maximize the number of replicated populations, different donor WCT populations will be used whenever practical for each expansion. Due to the possibility of local adaptations, donor populations living near the expansion site will be selected when practical. However, it may be necessary for the source WCT to be from a distant drainage, when a local pure population can not be found for the transfer. WCT transferred from the Highwood Mountains to the Two Medicine Drainage on the Rocky Mountain Front have done very well for decades. Another possible source of pure WCT is the Montana Fish, Wildlife and Parks WCT brood stock located at the Anaconda State Fish Hatchery. This brood stock was created from several WCT stocks west of the divide. This brood stock is the best hatchery-raised WCT available today. Currently there is not a policy to use the Anaconda WCT east of the Continental Divide, but in instances where hundreds of WCT must be stocked or it is necessary to establish a put and take fishery, they are the only choice unless an east side brood stock is developed.

WCT Transfer Guidelines

The WCT technical committee, composed of several Montana, State and Federal Fisheries Biologists, has developed several criteria to minimize risks of fish transfers (Oswald et al. 1995, Leary et al. 1998) which will be followed in northcentral Montana. Disease and genetic testing of donor populations will be completed prior to fish transfers. Only pure WCT will be used as donors. Based on recommendations of the WCT Technical Committee, donor populations for fish transfers will have a genetically tested sample size of 50 fish. To preserve local genetic adaptations, we have decided that smaller sample sizes may be used for headwater habitat extensions of WCT being transferred upstream. Transplanted wild and adult WCT will typically be used to establish new populations in northcentral Montana. The MFWP wild fish transfer policy will be followed and WCT will not be transferred until approved by the MFWP Fish Health Committee. Disease considerations and limited size of donor population may require experimenting with collection and incubation of wild WCT eggs (Leary et al. 1998).

Insect and amphibian evaluations of historically fishless receiving streams will be done prior to WCT transplants. On-site insect evaluations may not be done for small (less than 2 mile) upstream habitat extensions because several previous site evaluations have consistently found WCT introductions will not harm the biotic integrity of fishless reaches in northcentral Montana (Dr. Dan Gustafson, file reports). The two most common amphibians found along central Montana trout streams are western toads and spotted frogs, which have co-evolved with fish and have adapted to fish predation. These two species select side channel and slack water breeding sites that typically provide hiding cover for

their larvae and are not desirable foraging areas for adult trout large enough to prey on them. A third species, the tailed frog is found along the Rocky Mountain Front and also reproduces very successfully in mainstem areas of fish bearing streams. Therefore, it is unlikely WCT introductions to fishless reaches would impact amphibians, unless a specific breeding site for amphibians was found which was previously inaccessible to fish.

Summary

Approximately 40 – 50% of the original range of WCT in the Missouri River drainage is located in northcentral Montana (MFWP Region 4). Pure WCT only occupy about 5% of their historic range in northcentral Montana and only about 10% of the remaining pure populations likely have long term viability based on a recent assessment (Hilderbrand and Kershner 2000). This 10% occupies about one quarter of the remaining pure WCT habitat and about 1% of the historic habitat. The use of fish toxicants will be necessary if we are going to preserve many of the remaining populations, especially if we target an area that will support at least 2500 individuals. Non-native trout species currently occupy over 4,000 miles of habitat in northcentral Montana. Though there are no firm restoration targets yet, pure WCT will probably be re-established in just a few hundred miles of their original range in northcentral Montana. Virtually all of this will occur in small headwater reaches in mountainous areas and will be selected through the public consultation process. Restoration activities are expected to have minor effects on angling opportunity for rainbow trout, brook trout and brown trout and will probably improve recreational fishing opportunities for larger sized native trout in headwater areas. WCT are relatively easy to catch and are often larger than brook trout in northcentral Montana streams.

Restoration of viable WCT populations in northcentral Montana is a daunting but achievable task that can save our state fish for future generations of Montanans to enjoy. Because of many other responsibilities, existing fisheries staff in northcentral Montana will be able to make slow but steady progress on restoration goals. Timely progress on large-scale WCT restoration can only be accomplished if additional staff and resources are dedicated specifically to this effort.

Upper Missouri Tributaries

The Upper Missouri River tributaries include the tributaries from Hauser Reservoir downstream to the Smith River. Several pure and hybridized populations have been identified in this area (Figure 4, Tables 2 and 3), and includes two of the five streams in northcentral Montana that likely have populations exceeding 2500 pure WCT, Elkhorn Creek and Three Mile Creek. Major concerns for the pure populations are listed in Table 4. This area has had limited inventory but some monitoring is occurring (Table 5). A gabion barrier was built by MFWP and chemical rehabilitation using rotenone was completed in 1972 on Elkhorn Creek (Table 5). No WCT in the Dearborn drainage have been tested. The Falls Creek drainage (Dearborn) was historically fishless above a large falls near the mouth but rainbow trout and brook trout have been planted above the falls. MFWP surveyed the Upper Dearborn in the mid 1980's and found rainbow trout, WCT and WCT x rainbow trout upstream into the headwaters of Whitetail Creek. The USFS conducted fish inventories throughout the Dearborn Drainage from 1989 – 1992. These inventories included several streams in historical WCT habitat, including, Bald Bear, Blacktail, Dearborn, Lost Cabin, Lower Twin, Halfmoon, Milky, Welcome, and Whitetail. All of these streams contained brook trout and/or rainbow trout (data on file with the Lewis and Clark National Forest, Great Falls). Cutthroat trout were found in a few streams with rainbow trout. A few tributaries were fishless including Twin Buttes and Upper Twin. Stocking records indicate that the Dearborn River System (locations not known) was stocked with cutthroat trout throughout the first half of the twentieth century. Wild WCT are not known to have been transferred to the Dearborn drainage (Ed Nevala, MFWP Technician, retired, personal communications).

Future Work: An inventory of the headwater streams in the Upper Missouri needs to be completed to determine the current distribution of WCT. Extreme headwater reaches of the Dearborn should also be included in this inventory. Some WCT from the Dearborn River drainage need to be genetically tested. A survey of Prong Creek (South Fork Dearborn) is needed (Len Walch, Fisheries Biologist, Helena National Forest personal communication). Future Fisheries Program Funds have been obtained for a barrier on Cottonwood Creek (MFWP Beartooth Game Range) which, should be completed by fall 2000 (Table 6). Discussions are ongoing to select a donor population for this stream. Willow Creek, tributary to Elkhorn Creek, is a fishless reach that may have the potential to support WCT (Len Walch, Helena Fisheries Biologist, personal communications).

Possibilities for Interconnected Habitat: A large barrier falls exists on Falls Creek (Dearborn) but a thriving brook trout and rainbow trout population exists above the falls, so a massive chemical rehabilitation effort would be needed before this area could be used as WCT habitat. Approximately 20 miles of trout habitat is located above the falls, but the habitat is fragmented by two other falls.

Figure 4. WCT distribution in the Upper Missouri Tributaries

Table 2. Characteristics of WCT populations, that are at least 90% pure, in the Upper Missouri tributaries.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
Elkhorn Cr.	Excellent	Man-made gabion	None	8 (includes N. and S. Fks.)	100		1996
Elkhorn Cr., N. Fk.	Excellent	Man-made gabion on Elkhorn Cr.	None	8 total	100		1994
Elkhorn Cr., S. Fk.	Excellent	Man-made gabion on Elkhorn Cr.	None	8 total	100		1994
Page Gulch[3]			None		100		1997
Sawmill Gulch[2]	?	None	None	Unknown	95.4	Yellowstone cutthroat	1997
Skelly Gulch[2]	Excellent	Culvert and dry	None	3.5	100		1991
Rooster Bill [3]	Good	Culvert	Brook trout	2	100		1994
Specimen Cr.[3]	None		Brook trout		?		
Three Mile Cr.	Good	Private dam	None	About 5	100		1996

1 Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

2 Information provided by Archie Harper, Fisheries Biologist, Helena National Forest, personal communication.

3 Information provided by Laura Burns, Helena National Forest, personal communication.

Table 3. Characteristics of WCT populations, that are less than 90% pure, in the Upper Missouri tributaries.

Water (reach)	Population security from non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
Little Prickly Pear Cr., S. Fk.	None				65	Rainbow trout	1991
Sheep Cr., S. Fk.	None				55	Yellowstone cutthroat	1997
Trout Cr.	None				?	Rainbow trout, Yellowstone cutthroat	1990

[1] Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

Table 4. Issues for WCT streams in the Upper Missouri tributaries.

Stream	Habitat quality	Land ownership	Access	Major concerns	Comments
Elkhorn Cr.	Good	State	Public	No immediate threats.	Chemically treated in 1972. Took 3 years for remnant population in headwaters to repopulate stream.
Page Gulch[2]	Good	USFS			
Sawmill Gulch	Varies	USFS, BLM, Private		Barriers not identified.	Grazing impacts on private.
Skelly Gulch[1]	Good habitat with grazing impacts.	Private, USFS, BLM	Public and private	Grazing impacts.	Brook trout distribution stops at spring downstream of barrier.
Specimen Cr.[2]	Some grazing impacts.	Private, USFS			
Rooster Bill [2](Trib to Virginia)	Small stream with good habitat.	Private, USFS	Private and public (in headwaters)	Competition with brook trout. Culvert barrier on private land.	Small mining claim at mouth does not hurt WCT.
Three Mile Cr.	Unknown	Private, some USFS in headwaters.	Private	Urbanization of drainage.	Concern that people will move fish into drainage. Needs further inventory.

1 Information provided by Archie Harper, USFS, personal communication. 2 information provided by Laura Burns, USFS, personal communication.

Table 5. Recovery actions completed in the Upper Missouri tributaries.

Action	Stream	Date	Comments	Monitoring
Brook trout removal (Chemical)	Elkhorn Creek (Beartooth Game Range)	1972	In conjunction with barrier construction	Still brook trout free in 1998
Barrier construction	Elkhorn Creek (Beartooth Game Range) 8 mile reach	1972	A gabion structure was built, brook trout were chemically removed and WCT from the headwaters recolonized.	Monitoring in 1998 indicates pure WCT above barrier. Barrier maintenance ongoing
Electrofishing for genetics and abundance Fish community assessment / Whirling disease monitoring	Beaver Creek 5 miles	Ongoing		Even numbered years
	Big Prickly Pear Creek 10 miles	Ongoing		Even numbered years
	Cottonwood Creek 8 miles	Ongoing		Even numbered years
	Elkhorn Creek 11 miles	Ongoing		Even numbered years
	Hauser Tailrace 5 miles	Ongoing		Even numbered years
	Silver Creek 3 miles	Ongoing		Even numbered years
	Trout Creek 9 miles	Ongoing		Even numbered years
Gillnetting Fish community assessment / Whirling disease & Population trend monitoring	Hauser Reservoir	Ongoing		Annually
	Holter Reservoir	Ongoing		Annually
Creel survey Species composition / Population trend monitoring	Hauser Reservoir	Ongoing		Annually
	Holter Reservoir	Ongoing		Annually

1 Addition surveys have been done by the Helena National Forest on Skelly, Specimen, Rooster Bill, and other creeks.

Table 6. Possible introduction sites in the Upper Missouri tributaries.

Introduction site						Potential donor population characteristics		
				Survey information				
Stream	Barrier quality/ type	Fish species present	Length (mi)	Amphibian	Insect	Stream	Genetics	Disease
Cottonwood Cr. (Beartooth Game Range)	To be built	Brook trout, rainbow trout (to be removed)	6	Not applicable	Not applicable	Daniels Cr. (Smith) Deep Cr. (Smith) Elkhorn Cr.	N=25 N=59 N=35	None 7/00
Willow Cr.[1]	Dry	None	Not known	No survey	No survey	Elkhorn Cr.	N=35	Not done

1 Len Walch, personal communications, fisheries biologist, Helena National Forest

The Smith River Drainage

Extensive non-native trout populations and irrigation demands on private land have had big impacts on the native WCT populations in the Smith drainage. Most of the remaining WCT populations in the Smith are hybridized with rainbow trout. Figure 5 shows the distribution of existing WCT and associated barriers in the Smith drainage. Tables 7 and 8 and Appendices A and B summarize statistics of WCT populations. In most cases, barriers (Figure 5) protect pure populations. Specific issues for these populations are listed in Table 9. WCT work in the Smith has included surveys, headwater introductions and some fencing projects (Table 10). Based on population surveys done during the 1990's the Deadman WCT population may be extinct. Richardson Creek has a pure WCT population and 50 WCT from this population were transferred into Upper Fourmile Creek in May and June 2000. Additional transfers are planned for 2001.

The best populations of WCT in the Smith are in Deep Creek and Cottonwood Creek, which usually have dry channel barriers that provide some protection from downstream non-native trout. Cottonwood Creek (Castle Mountains) has about 4 miles of WCT habitat with no other trout species present. The North Fork Deep Creek population has about 4 miles of habitat with two waterfalls that protect the upstream 3 miles of habitat. The habitat above the upper waterfall was fishless until the late 1980's when the Forest Service transferred about 100 WCT from below the waterfall. In July 2000 (during drought), surveys of Deep Creek found that the North and South Forks were dry where they joined and downstream from their confluence. The South Fork of Deep Creek had about 2 miles of habitat with an additional 2 miles of good fishless habitat upstream of a 15 foot waterfall.

Future Work: There are a few possibilities for headwater introductions into fishless reaches in the Smith River drainage (Table 11). The best of these is probably on the South Fork of Deep Creek. Other headwater transfer possibilities that need further inventory, include Upper Little Camas Creek above a culvert (Len Walch and Archie Harper, personnel communication) and Stringer Creek. A fishless headwater site on Cottonwood Creek in the Castle Mountains (Shepard and White 1999) is too small in dry years to support WCT.

In the Hound Creek drainage, Middle Creek Reservoir, Hound Creek Reservoir and their tributaries are in the process of being inventoried as a potential reintroduction sites for WCT. Reintroduction of native WCT into these reservoirs will require chemical rehabilitation to remove non-native trout, since Middle Fork Reservoir currently contains apparent hybrid cutthroat trout and Hound Creek Reservoir is stocked with rainbow trout (Liknes 2000a and 2000b). In conjunction with this project, the North Fork Deep Creek (Smith) and Cottonwood Creek (Smith) are undergoing disease and genetic testing as possible donor populations.

Additional inventories and testing need to be completed in the Smith system. Sites that have been previously identified which may contain native WCT (Wipperman and Constan, 1973) and need inventories include Rugby Creek, Fisher Creek, Wolsey Creek, Jumping Creek and others. Thirteen WCT were found in Jumping Creek in 1998 but none have been found since. No WCT were found in Wolsey Creek in the early 1990's. WCT populations in these two streams are likely extinct or nearly extinct. Additional inventory is also needed on private land in Thompson Gulch and Elk Creeks, since the USFS has found a few WCT in the far headwaters of these streams (Len Walch and Archie Harper, Fisheries Biologists, Helena National Forest, personal communications). Camas Lake and the Middle Fork Camas Creek need to be surveyed and tested. Stocking of Edith and Baldy Lakes in

the headwaters of the Birch Creek drainage is in the process of being changed from Yellowstone cutthroat to WCT.

The South Fork of Willow Creek contains 99% pure WCT and should be protected from further rainbow trout hybridization. Biologists need to work with the White Sulphur Springs water district to ensure that operation of the reservoir and bypass channel on South Fork Willow Creek does not allow rainbow trout to get above the bypass weir.

Possibilities for Connected Habitat: North Fork of Deep Creek probably has close to the 2500 WCT population recommended for long-term survival. Additional connected habitat, even for 5 miles of stream, in the Smith would require chemical removal of non-native trout, often in areas supporting slightly hybridized WCT. Tenderfoot Creek has the potential for nearly 50 miles of connected habitat, above a large waterfall barrier. However, Shepard et al. (1997a) believe that it would be extremely difficult to remove non-native brook trout from Tenderfoot Creek and therefore, would not be a good candidate stream for restoration of a population of native WCT. Tenderfoot Creek also supports a popular recreational fishery. The only possibility for interconnected habitat in the Big Belts is Upper Camas Creek, which offers a potential of 35 miles of connected habitat (Archie Harper, personal communication). WCT restoration in Camas Creek would require inventory of barrier sites, barrier construction and eradication of non-natives.

Figure 5. WCT distribution in the Smith River drainage

Table 7. Characteristics of WCT populations, at least 90% pure, in the Smith River drainage.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
Big Camas Cr.			Brook trout	3.3	96	Yellowstone cutthroat	1991
Cottonwood Cr. (E. Fk & W. Fk.)(from Shepard and White, 1999)	Good	Dry stream section created by subsurface flow and irrigation	None	4.3	100		1992
Daniels Cr.	Good	Irrigation diversion	None	3	100		1994
Deadman Cr. (N. Fk.)	None	None	Brook trout	WCT nearly Extinct	100		1989
Deep Cr. (N. Fk)	Unknown for most downstream population. Upper stream good.	Dry barrier and waterfalls. Two waterfalls fragment population.	None	4	100		1985 (samples from 2000 pending)
Deep Cr. (S. Fk)	Unknown	Dry barrier	None	2	97?	Rainbow trout	1988 (samples from 2000 pending)
Fourmile Cr.	Unknown	Dry barrier	Brook trout	4	96	Yellowstone cutthroat	1994
French Cr., Lower/Upper	Unknown, may be very low.	Two barriers, one due to mining activity. Rainbow trout hybridization possible.	None	1.5	100		1990
Iron Mines Cr.	Excellent	Water fall	None	2.5	91	Yellowstone cutthroat	1998
Richardson Cr.	Poor	Cascade	Brook trout	1.5	100		1999
Slough Cr. (Elk Cr.)	Very low	Unknown	Brook trout	0.3	Not tested		
Tenderfoot Cr. (S. Fk.)	Good	Waterfalls	None	4	96	Yellowstone cutthroat, Rainbow trout	1998
Tenderfoot Cr., Upper	Good Populated by non-natives	Series of waterfalls.	Brook trout Rainbow trout	3	90 (84%in Lower Tender -foot)	Rainbow trout	1992
Willow Cr. (S. Fk).	Partial	Reservoir bypass channel may allow rainbow trout access.	Brook trout	3	99	Rainbow trout	1999

[1] Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

Table 8. Characteristics of WCT populations, less than 90% pure, in the Smith River drainage.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
Adams Cr.	None		Brook trout	2	60	Rainbow trout	1990
Atlanta Cr.	Partial	Irrigation intake at Forest Service boundary	Brook trout	2.2	83	Yellowstone cutthroat	1991
Big Birch Cr.	None	None		?	?		Never tested Assumed hybridized from upstream lakes
Balsinger Cr.	None	None	?	3	84	Rainbow trout, Yellowstone cutthroat	1988
Black Butte Cr.	Excellent	Waterfall	None	8	75	Yellowstone cutthroat	1996
Eagle Cr.	None		Brook trout rainbow, rainbow X WCT	?	Not tested		
Lake Cr.	Unknown	Dry (not well evaluated)	None	2	71 (preliminary)	Yellowstone cutthroat, Rainbow trout	2000
Little Camas Cr.	None	None	Brook trout	1.0	82	Yellowstone cutthroat	1990
Tenderfoot Cr.	Excellent but non-natives thrive here	Falls	Rainbow trout, brook trout	13 total	84	Rainbow trout	1988

[1] Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

Table 9. Issues for WCT streams in the Smith River drainage.

Stream	Habitat quality	Land ownership	Access	Major concerns	Comments
Big Camas Cr.				Water appropriations below USFS	
Cottonwood Cr. (E. Fk and W. Fk.)	Some reaches of stream have moderate road, grazing and logging impacts.	USFS/Private	Private	Best habitat on private land	Little fishing pressure.
Daniels Cr.	Small stream size and major livestock impacts limited habitat	Private/ USFS	Private & public	Isolated small stream reach vulnerable to drought.	Irrigation structure at mouth is a barrier. Potential donor for headwater transfers.
Deadman Cr. (N. Fk. & S. Fk.)	Road impacts. Stream very silty.	USFS	Public	Competition with brook trout. Very silty.	WCT may be extinct in this drainage.
Deep Cr. (N. Fk)	Excellent habitat.	USFS	Public trail	No immediate threats	Population may have close to 2500 individuals.
Deep Cr.(S. Fk)	Good habitat	USFS	Public trail	No immediate threats – Potential from downstream rainbow trout introgression unknown.	Headwater extension would add about 2 miles of habitat.
Fourmile Cr.	Some road and grazing impacts.	USFS	Public	Competition with brook trout.	Headwater expansion from Richardson Cr. population in 2000.
French Cr., Lower/Upper	Mining activity and grazing.	Private, USFS	Private	Rainbow trout may have access to this reach.	
Iron Mines Cr.	Good	USFS	Public	No immediate threats	Headwater pond has good habitat value
Richardson Cr.	Very small stream above cascade to Fourmile Cr. Livestock impacts.	USFS	Public	Competition with brook trout. Potential for hybridization with Fourmile fish.	Tributary to Fourmile Cr.
Tenderfoot Cr. (S. Fk.)	Good habitat but has extensive grazing and road impacts.	USFS	Public	Grazing, road sediment.	Very healthy WCT population (no brook trout competition).
Tenderfoot Cr., Upper	Good	USFS	Public	Competition with brook trout.	
Willow Cr. (S. Fk).	Good. Drainage protected from development since it is a municipal water supply.	USFS	No public access since stream is the White Sulphur Spring water supply.	Competition with brook trout.	Reservoir exists at downstream end of reach. However, looks like fish could negotiate bypass weir.

Table 10. Recovery actions completed in the Smith Drainage.

Action	Stream	Date	Comments	Monitoring
Fencing projects	Black Butte Cr.	1997	Riparian pasture	1998 – stream banks recovering
Grazing plans	Fourmile Cr. Richardson Cr. Grasshopper Cr.	1997	New pastures, utilization rates and seasons.	
Stream stabilization projects	Richardson Cr.	1998	Placed downed trees along creek banks to protect from livestock trampling.	1999 – only about 25% effective
Brook trout removal (electrofishing)	Fourmile Cr.	1995-1998	Above Fourmile Springs	Discontinued since hybrid population.
	Richardson Cr.	1999		Ongoing removal
	Willow Cr. (S. Fk.)	1999		Ongoing removal
WCT headwater expansions	Deep Cr., N. Fk.	About 1988	About 100 moved	WCT present above upper falls in 2000.
	Fourmile Cr.	1998 – 1999	50 WCT moved May/June 2000 from Richardson Cr.	Will move more in 2001.

Table 11. Potential headwater introduction sites in the Smith River drainage.

Introduction site						**Potential donor population characteristics**		
	Barrier quality/ type	**Fish species present**	**Length (mi)**	**Survey information**				
Stream				**Amphibian**	**Insect**	**Stream**	**Genetics**	**Disease**
Upper Little Camas Cr.	Culvert	None	1.5	No survey	No survey	Daniels Cr.	100% N=25	
Deep Cr., S. Fk.	Waterfall	None	2	No survey	No survey	Deep Cr., S. Fk Deep Cr., N. Fk	?97% more samples taken in 2000 100% N=59 more samples taken in 2000	 Sampled 7/2000
Stringer Cr. (Shepard et al. 1997a)	Waterfall	None	About 1	No survey	No survey	Deep Cr., N. Fk. Daniels Cr.	100% N=59 100% N=25	Sampled 7/2000

The Sun River Drainage

The Sun River has healthy populations of non-native trout. The Upper Sun River above Diversion Dam is thought to have been fishless prior to introductions made early in the twentieth century. Limited surveys have been done in the headwaters of the basin, which is a recent introduction site for fluvial arctic grayling. Distribution of WCT populations and barrier sites are identified in Figure 6. Pure WCT populations have not been identified in this drainage (Figure 6, Table 12). Specific issues for each population are listed in Table 13. Smith Creek, Ford Creek and Willow Creek, in the native WCT range, have slightly hybridized WCT populations. Gates Creek in the Upper Sun contains slightly hybridized WCT of unknown origin. The North Fork Sun River and Wrong Creek also have hybridized populations (Table 13). Other (not tested) North Fork tributaries with populations of cutthroat include McDonald Creek, Monroe Creek and Open Creek. WCT restoration within the Sun drainage has been primarily confined to surveys and grazing management (Table 14, Appendix B), however preliminary inventories for headwater introductions have been done for Petty Creek (Table 15). Rock Creek, North Fork Ford Creek and Willow Creek also offer headwater expansion opportunities (Table 15). Rock Creek is fishless but was stocked (unsuccessfully) with arctic grayling decades ago.

Future work: Inventory of headwaters of Smith Creek is a priority. Elk Creek should also be inventoried, but based on local reports, is unlikely to contain WCT. Introducing WCT to Petty Creek should be done as soon as a good donor source is identified. Preliminary work for headwater introductions into North Fork Ford Creek, Rock Creek and Willow Creek should also be completed. Testing of more WCT in the upper headwaters of the Sun, in McDonald Creek for example, may be worthwhile.

Possibilities for Connected Habitat: The potential connected habitat in Upper Smith Creek is about nine miles. Upper Smith Creek contains rainbow, brook trout and hybridized WCT above a major falls barrier. The upper North Fork of the Sun, which, has no known mainstem barriers, contains rainbow, brook and hybridized WCT for a total in excess of 30 miles. Fishless reaches of Rock Creek and the North Fork of Ford Creek may have enough habitat to support secure populations of at least 2500 WCT.

Figure 6. WCT distribution in the Sun River Drainage.

Table 12. Characteristics of WCT populations in the Sun River drainage.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
Ford Cr., N. Fk.	Fishless above barrier	Waterfall (series)	Brook trout	0.5 mile to barrier	94	Rainbow trout, Yellowstone cutthroat	1993
Gates Cr.	Excellent	Waterfall	None	2	94	Rainbow trout	1998
Lime Gulch	Excellent	Waterfalls on Little Willow Cr.	None	1	98	Yellowstone cutthroat	1998
Little Willow Cr.	Excellent	Waterfalls	Brook trout	3	97	Yellowstone cutthroat	1991
Moudess Cr.	Non-natives present	Waterfalls on Smith Cr.	Brook trout	2	92	Rainbow trout	1996
Smith Cr.	Non-natives present	Waterfalls	Brook trout	6	Not tested		
Sun, N. Fk.	None		Rainbow trout, brook trout	?	91	Rainbow trout, Yellowstone cutthroat	1998
Wrong Cr.	None		Rainbow trout	5	88	Rainbow trout, Yellowstone cutthroat	1998

[1] Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

Table 13. Issues for WCT streams in the Sun River Drainage.

Stream	Habitat quality	Land ownership	Access	Major concerns	Comments
Ford Cr., N. Fk.	Functioning, low grazing impacts. Excellent habitat in most areas.	USFS	Public	No immediate threats.	Most of stream fishless. Good candidate for upstream transfer.
Gates Cr.	Good habitat in Wilderness setting.	USFS	Public – No motorized vehicle access	No immediate threats.	Unlikely part of native range.
Lime Gulch	Functioning, low grazing impacts. Very small stream.	USFS	Public	No immediate threats.	
Little Willow Cr.	Riparian is at risk in some reaches. Areas of high grazing impacts	USFS	Public	Grazing impacts.	Needs exclosure fencing in vulnerable areas.
Moudess Cr.	Small unproductive stream with fair habitat quality. Sparse population.	USFS	Public trail	WCT suffering from competition with brook trout.	
Smith Cr.	Functioning, low grazing impacts	Private, USFS	Public trail/private	WCT suffering from competition with brook trout.	Hybridized above falls.
Sun River, N. Fk.	Good habitat in wilderness setting.	USFS	Public – No motorized vehicle access	No immediate threats.	Unlikely part of native Range. Fluvial arctic grayling introduced to area in 1999.
Sun, N. Fk. Tribs	Good habitat in wilderness setting.	USFS	Public – No motorized vehicle access	No immediate threats.	Unlikely part of native range.

Table 14. Recovery actions completed in the Sun River drainage.

Action	Stream	Date	Comments	Monitoring
Grazing plans	Ford Cr., N. Fk.	1997	New utilization rates and seasons.	
	Little Willow Cr.	1997	New utilization rates and seasons.	
	Petty Cr.	1990's	New utilization rates and seasons.	
Fencing projects	Little Willow Cr.	1980's		Rebuilt in 1990's. Monitoring for integrity.
Stream stabilization projects	N. Fk. Ford Cr.	Early 1990's	Log drop structures installed.	Limited monitoring
Pre survey for WCT headwater expansion	Petty Cr.	1998:invertebrate & amphibians	Upper reach has some grazing impacts.	

Table 15. Potential introduction sites in the Sun River drainage.

Introduction site						Potential donor population characteristics		
	Barrier quality/ type	Fish species present	Length (mi)	Survey information				
Stream				Amphibian	Insect	Stream	Genetics	Disease
Ford Cr., N. Fk.	Excellent series of waterfalls	None	5	No survey	No survey	Not yet identified		
Hoadley Cr.	Excellent waterfalls throughout	None known	4 frag-mented	No survey	No survey	Not yet identified		
Rock Cr.	Waterfalls	None	>10	No survey	No survey	Not yet identified		
Petty Cr.	Excellent waterfall	None	3	Completed 1998	Complete 7/31/1998	Not yet identified		
Willow Cr.	Excellent waterfalls	None	2	No survey		Not yet identified		

The Belt Creek Drainage

The distribution of WCT populations in Belt Creek is shown in Figure 7. Belt Creek contains the highest number of pure WCT populations and the most miles of stream occupied by pure WCT found in any northcentral Montana drainage. (Table 1 and Table 16). Unfortunately, most of the pure populations have a high risk of extinction because they likely contain less than 2500 WCT (Hilderbrand and Kershner 2000). Belt Creek also has several slightly hybridized (Table 16) and very hybridized WCT populations (Table 17). Pilgrim Creek, which is slightly hybridized, probably contains well over 2500 WCT. Barriers protect some of the remaining pure populations (Figure 7). However, many WCT populations suffer from competition with brook trout and several populations are at risk of hybridization with rainbow trout (Table 18). For example, WCT are now rare in the Middle Fork Belt Creek where brook trout colonized after the 1950's. The WCT population in Logging Creek is confined to the extreme headwaters and may even be extinct. Contamination from old mining claims pollutes much of the Belt Creek drainage, but mine waste also provides barriers that protect some populations, such as the WCT population in Upper Carpenter Creek. A variety of recovery efforts have been undertaken to benefit WCT in Belt Creek drainage (Table 19). These actions include extensive surveys (Appendix B), a headwater transfer on Lost Creek in 1997 (Tews et al. 1999), barrier construction, fencing, modification of grazing, and brook trout removal.

Future Work: There are numerous possibilities for barrier construction in the Belt Creek drainage. Sites on Pilgrim Creek and Harley Creek have already been investigated (Table 19). Permanent barriers need to be constructed on Jefferson and Chamberlain Creek. Brook trout removal efforts have increased WCT numbers in Chamberlain Creek and will need to be continued. Upper Gold Run Creek offers an upstream transfer opportunity (Table 20). Extinction risk for this population would drop if the 0.25 miles of occupied habitat was increased by more than a mile with this transfer. WCT sampling in main Belt Creek should be done to determine the WCT population structure. The headwaters of Harley Creek need to be sampled as well.

Possibilities for Connected Habitat: There are no obvious possibilities for 50 miles of connected habitat in the Belt Creek drainage. Smaller amounts of interconnected habitat would require building barriers and removal of non-native trout. About 20 miles of interconnected habitat could be created in the headwaters of the Dry Fork of Belt Creek. Mine pollution protects the upper reaches from rainbow trout invasion and would need to be cleaned up (unlikely) after a barrier was installed for this large reach to be connected. About 14 miles could be interconnected in the upper Belt and Jefferson drainages, which receives intense public use. Recent information indicates that the Jefferson population is slightly hybridized (Robb Leary, University of Montana, personal communications). Brook trout have severely limited the WCT in this area and would need to be removed. Regulation modification to allow WCT harvest would be necessary for public support. This area would be very susceptible to sabotage due to extensive road access. Pilgrim Creek has about 10 miles of connected habitat but WCT in the lower reaches are slightly introgressed with rainbow trout, which apparently have surmounted an existing bedrock chute at some time in the past.

On Little Belt Creek, it may be feasible to construct a barrier below the confluence of the Middle Fork and the North Fork, which would create about 4 – 5 miles of secure WCT habitat that would support close to 2500 WCT. To create that much secure habitat, the barrier would need to be built on private land and chemical removal of brook trout would be necessary.

Figure 7. WCT distribution in the Belt Creek Drainage.

Table 16. Characteristics of WCT populations, that are at least 90% pure, in the Belt drainage.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	hybrid	Year (last tested)
Belt Cr., Upper	Good	Box culvert	Brook trout	5-6	100		1998
Belt Cr., Upper Trib	None			2-3	97	Rainbow trout	1996
Carpenter Cr.	Excellent	Concrete pad, waterfall, mining pollution	None	2-3	100		1997
Chamberlain Cr.	Poor	Man-made bridge attachment	Brook trout	5	100		1998
Gold Run Cr.	Good	Mining contaminants	Brook trout	2-3	Pending		
Gold Run Cr., Upper	Excellent	90 foot waterfall	None	0.25	Pending		
Graveyard Gulch	Poor	Cascade with overflow channel	Brook trout	1.5 above barrier	100		1995
Harley Cr., Lower	None		Brook trout, rainbow		Pending		1999
Harley Cr., Upper	None		None	3 total	100		1996
Harley Cr., Upper Trib	None			3 total with trib	Pending		1999
Hoover Cr., N. Fk. (AB)	Poor	Small waterfall	Brook trout	5 total	98	Yellowstone cutthroat	1998
Horn Cr.	None		Brook trout	2	?		
James Cr.	None		Brook trout	2	?		
Jefferson Cr.	None		Brook trout		98 (prelim)	Yellowstone cutthroat	1999
Little Belt Cr., M. Fk., upper	Excellent	Waterfall	None	1	100		1997
Little Belt Cr., M. Fk.	None	None	Brook trout	1	?		
Little Belt Cr., N. Fk., Upper	Excellent	Waterfall	None	1.5	100		1996
Little Belt Cr., N. Fk., Lower	None		Brook trout	few WCT here	?		
Logging Cr.	None		Brook trout, rainbow	2	100		1989
Lost Cr.	Excellent	Waterfall	None	3	100		1996
O'Brien Cr.	Excellent	Reservoir dam	None	4	93	Rainbow	1997
Oti Park Cr.	None		Brook trout	5	100		
Pilgrim Cr.	Moderate	Waterfall		10(total)	94	Rainbow trout	1990
Pilgrim Cr., Upper	Moderate	Not isolated from lower Pilgrim	None	5	100		1995
Sawmill Cr.	Good	Culvert	None	3	100		1995
Shorty Cr.	Excellent (but hybrids can access)	Dam on O'Brien	None	1	100		1997
Spruce Cr.	Moderate	Small waterfall	Brook trout	0.5	100		1997
Tillinghast Cr.,	None known		Brook trout	About 5	100		1996

[1] Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

Table 17. Characteristics of WCT populations, that are less than 90% pure, in the Belt Creek drainage.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT Habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
Blanding Gulch	None		Brook trout, rainbow trout	1-2	77	Rainbow trout, Yellowstone cutthroat	1998
Crawford Cr.	Partial	Concrete water diversion modified by USFS	None	1-2	67	Rainbow trout, Yellowstone cutthroat	1997
Hoover Cr., S. Fk.	None		Brook trout	2	88	Rainbow trout	1996
Rafferty Cr.	None		Brook trout, rainbow	2	89	Rainbow trout	1995

[1] Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

Table 18. Issues for WCT streams in the Belt Creek drainage.

Stream	Habitat quality	Land ownership	Access	Major concerns	Comments
Belt Cr., Upper	Fair	Private/USFS	Public	Road sediment and highway sand.	
Belt Cr., Upper Trib	Good	Private/USFS	Public	No immediate threats.	
Carpenter Cr.	Good above mining. Small stream.	Private/USFS	Public	Isolated population vulnerable to drought and fire effects.	Probable donor population
Chamberlain Cr.	Excellent habitat.	USFS	Public	Competition with brook trout.	Ongoing brook trout removal, need to replace barrier.
Gold Run Cr., lower	Nice pools but very low trout numbers. May be water quality/quantity problems.	Private	Private	Competition with brook trout.	Downstream barrier provided by mining pollution.
Gold Run Cr., Upper	Good pools but a very short length of stream.	USFS	Private	Only 0.25 miles of habitat; vulnerable to stochastic extinction.	A 90-foot waterfall separates this population from brook trout. Possibilities for upstream transfer to over 1 mile of fishless stream
Graveyard Gulch	Good habitat with nice pools.	USFS	Public	Rainbow trout & brook trout invasion.	Partial falls barrier could be enhanced.
Harley Cr.	Good habitat with nice pools.	USFS	Public	Rainbow trout & brook trout invasion.	Very cold stream; consider barrier.
Harley Cr., Lower	High velocity, fair habitat. Some road impacts.	USFS	Public	Rainbow trout & brook trout invasion. Road impacts.	Road obliteration would improve riparian habitat.
Harley Cr., Upper Trib	Small stream with some grazing impacts.	USFS	Public	Rainbow & brook trout invasion.	

Table 18 Continued. Issues for WCT streams in the Belt Creek drainage.

Stream	Habitat quality	Land ownership	Access	Major concerns	Comments
Hoover Cr., N. Fk	Excellent habitat in good condition.	USFS	Public	Competition with brook trout.	
Hoover Cr., N. Fk. (AB)	Excellent habitat in good condition.	USFS	Public	Competition with brook trout.	Barrier needs evaluation. Concern that rainbow trout may get over barrier.
Horn Cr.	Very small stream with limited habitat.	USFS/Private	Public or private	Competition with brook trout. No known barrier from rainbow trout.	
James Cr.	Severe grazing impacts. Sedimentation problem.	USFS/Private	Public or private	Competition with brook trout. Grazing.	Very few WCT. Population in trouble.
Little Belt Cr., M. Fk.	Very good habitat.	Private/USFS	Public	Competition with brook trout.	Few remaining WCT in this fork.
Little Belt Cr., N. Fk., lower	Good habitat but high natural sediment levels.	Private/USFS	Public	Competition with brook trout.	A few WCT drop down from upstream.
Little Belt Cr., N. Fk., upper	Good habitat but high natural sediment levels.	Private/USFS	Public	Small isolated population. No immediate threats.	Excellent population, many large adults.
Logging Cr.	Some road and grazing impacts.	USFS	Public	Competition with brook trout and possible rainbow trout introgression.	This headwater population may no longer exist.
Lost Cr.	Small high gradient stair stepped stream. Nice habitat.	WCT on USFS	Private	Short isolated reach of stream. No immediate threats.	A waterfalls separates Lost Cr. from Otter Cr. WCT were stocked above a second falls in 1997.
O'Brien Cr.	Good habitat extends all the way to the headwaters, protected from development.	USFS/ private	Public or private	Rainbow trout introgression. Illegal brook trout introduction.	Neihart water system reservoir is a barrier. Assume people moved rainbow trout above reservoir dam.
Oti Park Cr.	Moderate to high grazing impacts.	USFS	Public	Competition with brook trout.	Ongoing brook trout suppression but need a long-term solution.
Pilgrim Cr.	Deep pools, abundant large woody debris and outstanding riparian vegetation; roadless area.	USFS	Public	Barrier needs to be enhanced to prevent upstream rainbow trout movement.	Lower reaches slightly hybridized with rainbow trout; population could sustain limited harvest.
Sawmill Cr.	Good habitat. Very rocky with some road impacts.	USFS	Public	No immediate threats	Closing road will benefit WCT but is controversial.
Shorty Cr.	Small stream with very limited habitat.	Private and USFS	Public	Rainbow trout hybridization.	Need more gene samples.
Spruce Cr.	Small stream with limited habitat.	USFS/ Private	Public or private	No immediate threats. Small isolated population	One of only a few remnant populations in the Dry Fork.
Tillinghast Cr.	Moderate to major grazing impacts.	USFS/Private	Public or private	Brook trout competition and rainbow trout hybridization. Grazing concerns.	Mixed land ownership presents many WCT management challenges.

Table 19. Recovery actions completed in the Belt Creek drainage

Action	Stream	Date	Comments	Monitoring
Fencing projects	James Cr.	1998		
Grazing management	Oti Park Cr.	1998	Revised grazing permits	Further modification needed to better protect stream.
Headwater expansion	Lost Cr.	1997	Moved fish in Lost Cr. from below barrier to above barrier. Nearly doubled habitat length to 2 miles.	Moved an additional 36 WCT in 1998. WCT from the first transfer were present. Pre survey done in 1997.
Barrier projects	Crawford Cr.	1990's	Modified barrier to prevent upstream trout passage at all flows.	
	Pilgrim Cr.	1999	Site visit and barrier evaluation.	
	Chamberlain Cr.	1996	Temporary barrier attached to current bridge.	Bridge will be replaced soon requiring a new barrier.
	Chamberlain Cr.	1999	Site visit to determine best way to make permanent barrier.	
	Graveyard Cr. (with Harley Cr.)	1999	Site inspection for potential barrier with culvert replacement.	May be done in conjunction with roadwork.
Brook trout removal (electrofishing)	Chamberlain Cr.	1997 – 1999		Ongoing removal
	Hoover Cr., N. Fk.	1998		Ongoing removal
	James Cr.	1998		
	Oti Park Cr.	1998 1999		Ongoing removal

Table 20. Potential headwater introduction site in the Belt drainage.

Introduction site						**Potential donor population characteristics**		
				Survey information				
Stream	**Barrier quality/ type**	**Fish species present**	**Length (mi)**	**Amphibian**	**Insect**	**Stream**	**Genetics**	**Disease**
Gold Run Cr.	Waterfall Excellent	None	1+	Not done	Not Done	Gold Run Cr.	Pending	Not done

The Highwood Creek and Shonkin Creek Drainages

Highwood Creek, Shonkin Creek and their tributaries have been well evaluated for WCT. WCT were present in the Shonkin drainage in the 1950's (Hanzel 1959) but were not found in recent surveys. WCT are on the verge of extinction in Highwood Creek. Only two streams in the Highwood Creek drainage, Big Coulee Creek and North Fork Highwood Creek now have WCT (Figure 8, Table 21). Both existing populations coexist with brook trout. Pohlod Creek had WCT and brook trout in the 1950's (Hanzel 1959), but WCT are now extinct in that stream. Management actions for WCT have included surveys (Appendix B), evaluation of potential barrier sites and brook trout removal (Table 22). The major issue for both streams is competition with brook trout (Table 23).

Future Work: Barrier construction should be evaluated on North Fork Highwood Creek. A small waterfall in the headwaters could be modified to create a barrier, but less than 2 miles of perennial habitat would be protected. Barrier construction needs to be completed on Big Coulee Creek.

Possibilities for Connected Habitat: There are no obvious sites for large interconnected WCT populations in the Highwood or Shonkin Creek drainages. Brook trout are well established in all streams and could easily be reintroduced into any rehabilitated stream.

Table 21. WCT Population characteristics in the Highwood Creek drainage.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
Big Coulee Cr.	No	No secure barrier	Brook trout	2	100		1998
Highwood Cr., N. Fk.	No	No barrier	Brook trout	1	?		Pending

[1] Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

Table 22. Recovery actions completed in the Highwood Creek drainage.

Action	Stream	Date	Comments	Monitoring
Barrier projects	Big Coulee Cr.	1999	Site inspection, funding and plans obtained. An additional site is being evaluated.	Not installed
Brook trout removal (electrofishing)	Big Coulee Cr.	1998, 1999	Movement of marked brook trout indicate barrier is passable.	Ongoing removal
	Highwood Cr., N. Fk.	1999		Ongoing removal

Table 23. Issues for WCT streams in the Highwood Creek drainage.

Stream	Habitat quality	Land ownership	Access	Major concerns	Comments
Big Coulee Cr.	Small high quality headwater reach with nice pools	USFS	Public – trail	Competition with brook trout.	Several potential barrier sites.
Highwood Cr., N. Fk.	Good. Some grazing impacts.	USFS	Public – trail	Competition with brook trout.	Barrier in headwaters may be feasible.

Figure 8. WCT distribution in Highwood Creek Drainage.

The Teton River Drainage

The Teton drainage is a very unproductive stream with low densities of WCT. Floods have severely impacted most of the habitat in the Teton drainage, and many reaches are subjected to severe icing conditions in winter. The distribution of WCT in the Teton drainage is shown in Figure 9. Most populations are slightly hybridized with rainbow trout (Table 24). Inventory of WCT populations is the major WCT recovery work completed in this drainage (Appendix B). In some areas only 2 – 4 WCT were shocked per stream mile (Appendix B). Stocking of Our Lake is in the process of being changed from Yellowstone cutthroat trout to WCT. This change will reduce the already low possibility of Yellowstone cutthroat trout in Our Lake hybridizing with fish in the East Fork Teton. Brook trout competition and poor habitat from past floods are the major issues for Teton streams (Table 25). There is limited opportunity in this drainage for WCT recovery. Several streams in the Teton drainage are fishless but are intermittent and likely would not support trout. These streams include Jones Creek, Massey Creek and Olney Creek. The North and South Forks of Deep Creek need additional surveys. During the 2000 field season, the South Fork of Deep Creek was identified as a potential introduction site with about 3 – 4 miles of good habitat.

Future Projects: Headwater introduction should be evaluated for the South Fork Deep Creek. Additional genetics samples need to be taken from Cow Creek and North Fork Willow Creek to further evaluate the purity of these populations. If pure, they may be good candidates to use for headwater introductions such as Petty Creek. Additional testing of WCT in headwater streams such as the North Fork Teton above the East Fork, Waldron Creek, Porcupine Creek and Bruce Creek needs to be completed. Construction of a barrier on the North Fork of Willow Creek on the Sun River Game range should be investigated. North Fork Waldron Creek should also be considered for replication if additional genetic testing confirms its purity. This WCT population is at a very high risk of extinction (only 1 mile of habitat) and may represent a unique genome.

Possibilities for Interconnected Habitat: There are no apparent options for 50 miles of interconnected habitat in the Teton Drainage. Chemical removal of non-natives and slightly hybridized WCT would have to be dealt with as well as building barriers. If these problems were solvable the West and North Forks of the Teton could provide a potential of 22 miles of interconnected habitat and the South Fork Teton and its tributaries could provide about 16 miles habitat.

Figure 9. WCT distribution in the Teton River Drainage

Table 24. WCT population characteristics in the Teton River drainage.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
Cow Cr.	Unknown	Old beaver dams	None	1.5	100		1990
Green Gulch, Lower	None		Brook trout		95	Rainbow trout	1994
Green Gulch, Upper	None		None	2	100		1993
Rierdon Gulch Lower Upper	Partial	Rock fall	Brook trout, mountain whitefish	2	 95 100	Rainbow trout	 1992 1994
Teton River, E. Fk.	Unknown	Potential barrier falls near mouth	Brook trout below falls	1.5	100		1996
Teton River, M. Fk.	None		Brook trout	3.5	94	Rainbow trout	1992
Teton River, N. Fk. (below E. Fk.)					96	Yellowstone cutthroat, rainbow trout	1998
Waldron Cr.	None			3	100		1992
Waldron Cr., N. Fk.	None		None	About 1	100		1990
Waldron Cr., S. Fk.	None		None	About 1	97	Rainbow trout	1992
Willow Cr., N. Fk.	Partial	Dry reaches at low flow, gradient	None	1.5	100		1990

[1] Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

Table 25. Issues for WCT streams in the Teton River drainage.

Stream	Habitat quality	Land ownership	Access	Major concerns	Comments
Cow Cr.	Moderate with some grazing impacts. Warm.	Private	Private	Invasion of non-native trout	No WCT populations were found on National Forest Service Lands in 1995.
Green Gulch, Lower	High gradient scoured stream. Some road impacts.	USFS, Public	Public	Brook trout competition	
Green Gulch, Upper	High gradient scoured stream.	USFS, Public	Public	Hybridization potential.	Brook trout have moved into area. Poor brook trout habitat.
Rierdon Gulch	Scoured stream channel.	USFS, Public	Public	Competition with brook trout.	
Teton River, E. Fk.	Cold sterile stream with low population densities. Limited habitat and cover.	USFS, Public	Public	Limited habitat.	
Teton River, M. Fk.	Scoured stream with very little good habitat. Road impacts.	USFS, Public	Public	Competition with brook trout.	
Waldron Cr.	Small stream with limited cover and some road impacts.	USFS, Public	Public		Need to retest Waldron
Waldron Cr., N. Fk.	Small stream with limited cover and some road impacts.	USFS, Public	Public	Hybridization potential	Need to retest Waldron
Waldron Cr., S. Fk.	Small stream with limited cover and some road impacts.	USFS, Public	Public		Need to retest Waldron
Willow Cr., N. Fk.	Good habitat on game range	Private/Public, FWP	Private/Public		Limited grazing is not impacting stream.

The Two Medicine River Drainage

The Two Medicine drainage contains the most secure remaining WCT populations and the second most occupied habitat (Table 1) in northcentral Montana. The distribution of these populations is shown in Figure 10. Many waterfall barriers are found in this drainage including a waterfall on North Badger Creek, which protects nearly 30 miles of habitat occupied by pure WCT (Figure 10). Population characteristics for WCT are listed in Tables 26 and 27. Extensive survey work has been completed throughout the Two Medicine drainage (Appendix B) except for Glacier National Park and the Blackfeet Indian Reservation. WCT habitat in the Two Medicine is located in remote USFS land. Brook trout competition, rainbow trout introgression and some grazing impacts are the primary issues in this drainage, but this is one drainage where several WCT populations have no immediate threats. (Table 28). WCT recovery actions (Table 29) have included two upstream transfers of WCT into fishless reaches including transfer of 171 WCT by helicopter into South Fork Birch Creek in 1974 (Hill 1975) and recent introductions into the South Fork of Dupuyer Creek (Tews et al. 1999). Habitat improvement is planned on Dupuyer Creek (Table 29). The Middle Fork Dupuyer population has tested as pure WCT, however we have been told that WCT from west of the divide were stocked over 30 years ago by a previous landowner (letter on file with MFWP, Choteau Field Office).

Future Projects: There are several possibilities for headwater introductions in the Two Medicine drainage (Table 30). Insect surveys were done in 2000 on both Lonesome Creek and South Fork Badger Creek. Amphibian habitat does not exist on Lonesome Creek, but needs to be evaluated in the headwaters of South Badger Creek. Middle Fork Birch Creek needs insect and amphibian surveys. Most of these streams have good to excellent habitat in the fishless reaches above the falls. Elbow Creek, a tributary to South Badger Creek has a thriving brook trout population, however upper South Badger is a cold high gradient stream with limited brook trout numbers. South Badger needs additional survey to better define the upper limit of WCT. Upper Whiterock Creek may support the last pure WCT population in the South Fork Two Medicine River; replication opportunities such as introduction into Lonesome Creek or Pike Creek should be investigated. Genetic samples are needed from the North Fork of Birch Creek. Additional surveys are needed on the Blackfeet Reservation and in Glacier National Park including Midvale Creek.

Possibilities for Interconnected Habitat: North Badger provides by far the best interconnected pure WCT habitat that is found in northcentral Montana. The current interconnected habitat is about 30 miles long and is protected by an excellent waterfall barrier. Headwater introductions to Lonesome and South Badger would add about 10 miles of pure WCT to the drainage. However, these creeks join main Badger Creek below the North Fork barrier where WCT are highly hybridized (Figure 7). Fifty miles of interconnected (upstream and downstream) WCT habitat is impossible to create in this area due to waterfall barriers. Theoretically the South Fork of the Two Medicine is a possibility for over 20 miles of connected habitat but would require removal of non-natives, barrier construction and further survey. The fishless headwaters of South Badger Creek may have the potential to support over 2500 fish.

Figure 10. WCT distribution in the Two Medicine River Drainage.

Table 26. Characteristics of WCT populations, that are at least 90% pure, in the Two Medicine drainage.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
Badger Cabin Cr.	Excellent	Waterfall on North Badger	None	2	100		1993
Birch Cr., S. Fk.	Excellent	Waterfalls	Brook trout	4	100		1995
Dupuyer Cr., M. Fk., above dam	Excellent	Dam	None	2	100		1997
Dupuyer Cr., N. Fk.	Excellent	8 foot waterfall	Brook trout	About 8	95	Rainbow trout	1990
Dupuyer Cr., S. Fk., Lower	Excellent	2 barrier waterfalls (private land)	Brook trout	2	94	Yellow-stone cutthroat	1994
Dupuyer Cr., S. Fk., Upper	Excellent	Waterfall	None	About 5 (includes Rival Cr.)	100		Transplant from Dupuyer, M. Fk. population
Lee Cr.	Excellent	Waterfall on North Badger	None	2	100		1985
Limestone Cr.	Partial	Waterfall	Brook trout below barrier		95	Rainbow trout	1996
Little Badger Cr., N. Fk.	Partial	Squashed culvert. Was probably not barrier when installed.	None	3	94	Yellow-stone	1996
Lonesome Cr.	Barrier above occupied habitat	Fishless above a waterfall	Brook trout	0.7 miles below barrier	94	Rainbow trout	1991
Lost Shirt Cr.	Unknown		None	2	92	Rainbow trout	1993
North Badger Cr.	Excellent	Waterfall	None	Over 20 miles total with tributaries	100		1985
Red Poacher Cr.	Excellent	Waterfall on North Badger	None	2	100		1992
Rival Cr.	Excellent	Waterfall	None	About 5 (includes Upper S. Fk. Dupuyer Cr.)	100		Transplant from M. Fk. Dupuyer population (100%)
Rowe Cr.	Unknown			1	93	Rainbow trout	1993

[1] Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

Table 26 continued. Characteristics of WCT populations, that are at least 90% pure, in the Two Medicine drainage.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
South Badger Cr.	Barrier above occupied habitat	Waterfall above WCT occupied habitat – 1 mile above mouth[2]	Brook trout	About 1 mile has fish below barrier	100		1990
Summit Cr.	Unknown		Brook trout, mountain whitefish	5	92	Rainbow trout	1992
Sidney Cr.	Unknown		None	2	98	Rainbow trout	1992
Two Medicine, S. Fk.	None	None	Brook trout, rainbow trout	More than 12	97	Rainbow trout	1984
Whiterock Cr.,	Temporary	Log Jam – reinforced by USFS	Brook trout	About 3 total	100		1994
Woods Cr.	Unknown		None	2	98	Rainbow trout	1984
Woods Cr., E. Fk	Unknown		None	2	100		1994

[1] Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

2 There is conflicting data from South Badger above the falls, WCT have been found within the falls.

Table 27. Characteristics of WCT populations, that are less than 90% pure, in the Two Medicine drainage.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
Badger Cr. (Below N. Fk Badger falls).	None	None	Rainbow trout, brook trout	Extensive	75	Rainbow trout	1992
Hungry Man	None	None	None	2.5	68	Rainbow trout	1992

[1] Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

Table 28. Issues for WCT streams in the Two Medicine drainage.

Stream	Habitat quality	Land ownership	Access	Major concerns	Comments
Badger Cabin Cr.	Small stream with limited cover and grazing impacts.	USFS	Public	No immediate threats.	
Birch Cr., M. Fk	Limited by low flows and scoured channel.	USFS	Public		Contains brook trout, WCTx rainbow and rainbow trout.
Birch Cr. N. Fk.	Unknown	USFS	Tribal		
Birch Cr., S. Fk.	Excellent habitat for WCT.	USFS	Public		Brook trout moved illegally into headwaters but poor brook trout habitat.
Dupuyer Cr., M. Fk.	Small stream primarily used for rearing. Limited habitat.	USFS/Private	Private	No immediate threats.	WCT found in irrigation pond and in 2 miles of stream above pond. WCT transferred from west of divide in 1960's (Choteau Office, MFWP, files).
Dupuyer Cr., N. Fk.	Good habitat but flow limited. Small stream. Minor road impacts	USFS	Private	No immediate threats.	Hybridized above last barrier.
Dupuyer Cr., S. Fk., Upper	Good habitat, with deep pools and beaver dam complex.	USFS	Private	No immediate threats.	WCT introduction above barrier in 1998.
Lee Cr.	Habitat limited by low flow. Minor grazing impacts.	USFS	Public	Minor grazing impacts.	
Limestone Cr.	Fair habitat, scoured with some pools.	USFS	Public	No immediate threats to hybrid WCT.	Grazing, but channel so rocky grazing is not causing impacts.
Little Badger Cr., N. Fk.	Minor road impacts. Good habitat.	USFS	Public		On-going hybridization from self-sustaining Yellowstone cutthroat in lakes on Blackfoot Reservation.
Lonesome Cr.	Over 4 miles of good fishless habitat above barrier waterfall.	USFS	Public	No immediate threats.	Brook trout have access to area below barrier, but are at low population levels.
Lost Shirt Cr.	Limited small stream habitat.	USFS	Public		
North Badger Cr.	Good habitat with some scouring. Isolated grazing impacts. Habitat in upstream reaches fragmented by series of falls.	USFS	Public	No immediate threats.	Some grazing impacts.
Red Poacher Cr.	Moderate grazing. Habitat limited in this small stream.	USFS	Public	No immediate threats.	
Rowe Cr.	Unknown	USFS	Public	No immediate threats.	

Table 28 Continued. Issues for WCT streams in the Two Medicine drainage.

Stream	Habitat quality	Land ownership	Access	Major concerns	Comments
South Badger Cr.	Excellent habitat. Great pools and good flows.	USFS	Public		Status of WCT here is unknown. Opportunity for WCT transfer
Summit Cr.	Major road impacts from Highway 2. Some scouring.	USFS, Private	Public, Private	Road impacts. Riparian development.	
Sidney Cr.	Unknown.	USFS	Public		Hybridization not known. Genetic results varied.
Two Medicine, S. Fk.	Scoured channel but good habitat. Large stream with pools & riffles, beaver ponds. Road & grazing impacts.	USFS	Public	Road/trail impacts. Competition with brook trout.	
Whiterock Cr., Lower	Small stream with grazing and trail impacts.	USFS	Public	Hybridization, brook trout competition. Road and grazing impacts.	May be last pure WCT remaining in S. Fk. Two Medicine drainage.
Whiterock Cr., Upper/ Middle	Some trail impacts. Small stream.	USFS	Public	Hybridization, brook trout competition. Road and grazing impacts.	May be last pure WCT remaining in S. Fk. Two Medicine drainage.
Woods Cr.	Small headwater stream. Good (pristine) habitat.	USFS	Public	Brook trout have access.	Hybridized
Woods Cr., E. Fk	Small headwater stream but good habitat with woody debris pools.	USFS	Public	Brook trout have access.	Possibly hybridized

Table 29. Recovery actions completed in the Two Medicine drainage

Action	Stream	Date	Comments	Monitoring
Stream/ habitat improvement projects	Dupuyer Cr., S. Fk.	Planned	Create pools in Creek.	
	Whiterock Cr.	1997	Rebuilding of Whiterock trail to reduce erosion.	Ongoing
	Whiterock Cr.	1995	Reinforced log jam structure	Needs annual monitoring and reinforcing. Has not been done.
Headwater expansion	Birch Cr., S. Fk.	1974	Transferred from N. Fk. Little Belt Cr. to fishless area above barrier.	In early 1990's sabotaged by illegal brook transplant. Now has 5:1 WCT:brook trout ratio.
	Dupuyer Cr., S. Fk./Rival Cr.	1998 & 1999	WCT transferred from Middle Fork of Dupuyer Cr. Above barrier. Increased habitat by about 5 miles.	

Table 30. Potential headwater introduction sites in the Two Medicine drainage.

Introduction site						Potential donor population characteristics		
				Survey information				
Stream	**Barrier quality/ type**	**Fish species present**	**Length (mi)**	**Amphibian**	**Insect**	**Stream**	**Genetics**	**Disease**
Birch Cr., Middle Fork	4 foot fall	Needs inventory	5-6	No surveys	No survey	Whiterock Cr. Woods Cr.	100%, N=17 100%, N=10	
Lonesome Cr.	Large waterfall	None	2-3	No amphibian habitat	July 2000	Whiterock Cr. Woods Cr.	100%, N=17 100%, N=10	
Pike Cr.	Waterfall	None	1-2	No survey	No survey	Whiterock Cr. Woods Cr.	100%, N=17 100%, N=10	
South Badger Cr. (lower)	Several waterfalls	Brook trout (rare) Elbow Cr. tributary has high numbers of brook trout.	6	Needs amphibian survey	July 2000	Whiterock Cr. Woods Cr.	100%, N=17 100%, N=10	
South Badger Cr. upper (above Crucifixion Cr.)	Falls	None	5 (in addition to lower 6)	Needs amphibian survey	July 2000	Whiterock Cr. Woods Cr.	100%, N=17 100%, N=10	

The Arrow Creek Drainage

Upper Cottonwood Creek and its tributary Boyd Creek contain the only known populations of WCT in the Arrow Creek drainage and constitute about 4 miles of habitat (Figure 11 and Table 30). Riparian fencing has been built in Upper Cottonwood Creek (Table 31).

Future Work: Additional tributaries to Arrow Creek should be inventoried including Fall Creek (State Land), headwaters of Martin Creek, and Davis Creek. It is unlikely that any of these areas support fish. A barrier has been designed for construction near the Forest Service boundary on Cottonwood Creek. The barrier will be constructed in 2000 or 2001 (Table 32). After barrier construction, intense brook trout removal by electrofishing will be done for at least 3 years. If brook trout are still present in the stream after this removal effort, chemical rehabilitation will be evaluated. Old beaver dams on Boyd Creek are disintegrating. Construction of man-made ponds could provide good overwintering habitat for WCT in this very small stream and provide an excellent barrier from the brook trout that inhabit Cottonwood Creek downstream. Such a project would require an on-steam WCT pond policy to be accepted and finalized and cooperation with a private landowner

Possibilities for Interconnected Habitat: No possibilities for large interconnected reaches of habitat have been identified in the Arrow Creek drainage.

Figure 11. WCT distribution in the Arrow Creek Drainage.

Table 31. WCT population characteristics in the Arrow Creek drainage.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
Boyd Cr.	Poor	Old beaver dams	None	1	100		1996
Cottonwood Cr.	None		Brook trout	3	100		1995

[1] Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

Table 32. Issues for WCT streams in the Arrow Creek drainage.

Stream	Habitat quality	Land ownership	Access	Major concerns	Comments
Cottonwood Cr.	Good habitat with localized grazing impacts; WCT in upper reach only.	USFS	Private or public via long trail	Competition with brook trout.	Good site for barrier construction on USFS land
Boyd Cr.	Very small stream	USFS and Private	Private	Very limited habitat now that ponds are gone.	Potential for old beaver dams to wash out and allow brook trout into stream.

Table 33. Recovery actions completed in the Arrow Creek drainage.

Action	Stream	Date	Comments	Monitoring
Fencing projects	Cottonwood Cr.	1998		1999 – good recovery
Barrier project	Cottonwood Cr.	Planned	Planning complete, contract awarded.	Installation planned for 2001
Brook trout removal (electrofishing)	Cottonwood Cr.	1998		Once barrier is installed will need to eliminate brook trout above barrier.

The Judith Drainage

The Judith drainage contains several pure and slightly hybridized populations (Table 34, Figure 12). Two populations with <90% pure WCT have been tested (Table 35). The Middle Fork and South Fork of the Judith River both have rainbow trout and brook trout in the lower reaches with WCT in the headwaters. The Upper South Fork Judith contains few brook trout that have coexisted with rainbow and WCT for years and appear to have limited impact on WCT. North Fork Running Wolf Creek, Cottonwood Creek and East Fork of Spring Creek have dewatered stream reaches that prevent access from downstream non-native trout during most flows. The rest of the populations in this drainage have no known barriers to prevent rainbow trout and brook trout from colonizing WCT habitat. Rainbow trout hybridization is a primary threat to many Judith populations (Table 36). Grazing and brook trout are threats to WCT on some streams (Table 36). WCT work in the Judith drainage has concentrated on inventory (Appendix B). Extensive inventory and genetic sample survey was completed on the South Fork Judith in 2000. Brook trout removal, grazing modifications and some stream projects have also been implemented (Table 37).

Future Work: Additional inventory and genetic testing is needed in the headwater reaches of the Judith River. Barrier construction and brook trout eradication should be evaluated at Placer Creek. A culvert barrier should also be considered on North Fork Running Wolf Creek to prevent encroachment of brook trout. The North Fork Running Wolf population occupies extremely limited habitat and should be considered for transfer to other streams. Two fishless headwater sites with very limited habitat (Table 38) should be further evaluated for introduction possibilities.

Possibilities for Connected Habitat: The Upper South Fork Judith has several pure populations in the headwaters, which could be interconnected to about 20 miles of habitat. Creating connected habitat in the Judith would involve eliminating brook trout and rainbow from miles of stream as well as building barrier(s). A management decision regarding the level of purity to strive for in the South Fork Judith needs to be made. WCT in the upper South Fork appear to be pure or slightly hybridized and preservation of all populations that are greater than about 95% should be considered. Such a population would serve as one of the interconnected large populations but could not be used as a source for new populations. There are several possible sites for barrier construction on the South Fork Judith. It would be possible to build a temporary barrier fairly high up in the drainage and secure those populations. Once the upstream populations were secure additional barriers could be built downstream for a larger population and the upstream barriers removed if desired. Electrofishing removal of non-native and hybridized trout may be feasible in the upper South Fork Judith since brook trout appear to have little impact on these populations. Barrier construction and non-native removal on the Middle Fork Judith would result in a long stream length but may not be feasible due to private land issues and difficulty of building a barrier.

Figure 12. WCT distribution in the Judith River Drainage.

Table 34. Characteristics of WCT populations, that are at least 90% pure, in the Judith drainage.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
Big Hill Cr.	Poor		None	2	100		1995
Bluff Mtn. Cr.	Good	Cascades		5	100		1997
Cabin Cr.	Unknown			About 4	96	Yellowstone cutthroat	1997
Cottonwood Cr., W. Fk. & E. Fk.	Partial	Dry barrier that flows during high water.	None	5 total	98	Rainbow trout	1996
Cross Cr.	None known			About 1	100		1997
Deadhorse Cr.	None		Mountain whitefish	About 4	100		1997
Dry Wolf Cr.	Good	Dry downstream	Brook trout	4	97	Yellowstone cutthroat	1994
Elk Cr.	None		Brook trout	About 1	100		1994
Harrison Cr., Upper	None		Brook trout, rainbow trout	2-3	100		1996
Judith River, S. Fk., Upper	None		Rainbow trout, brook trout, mountain whitefish	11 total	98	Rainbow trout, Yellowstone cutthroat	1984
Judith River, S. Fk., Upper	None		Rainbow trout, brook trout, mountain whitefish	11 total	100		1997
Placer Cr.	Poor	Dry reach below	Brook trout	3	100		1994
Running Wolf Cr., N. Fk	Poor	Dewatered reach runs during floods	None	2	100		1994
Russian Cr., Lower	None		Brook trout (few)	2 in lower	96	Rainbow trout	1996
Russian Cr., Upper	Good	Probably culvert barrier	None	< 1	100		1996
Snow Cr.	None		Brook trout	<1	100		1994
Spring Cr., E. Fk.	Fair	Dewatered reach that appears to rarely flow	None	2.5	Pending		
Weatherwax Cr.	None		None	About 4	91	Rainbow trout	1996
Yogo Cr.	None		Rainbow trout, brook trout	5	92	Rainbow trout	1994

[1] Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

Table 35. Characteristics of WCT populations, that are less than 90% pure, in the Judith drainage.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
Cleveland Cr.	None		Rainbow trout	6	85	Rainbow trout	1996
Lyon Gulch	Good	Dry reach	Brook trout	1	89	Yellowstone cutthroat	1994

[1] Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

Table 36. Issues for WCT streams in the Judith drainage.

Stream	Habitat quality	Land ownership	Access	Major concerns	Comments
Big Hill Cr.	Fair	USFS	Public	Grazing impacts	New exclosures are promoting riparian recovery
Bluff Mtn. Cr.	Limited by stream size.	USFS	Public	Hybridization with rainbow trout.	
Cabin Cr.	Limited by stream size.	USFS	Public	Additional hybridization with rainbow trout.	
Cottonwood Cr., W. Fk. & E. Fk.	Wide rocky stream with few pools and limited cover.	USFS	Public, Trail	No immediate threats.	Additional introgression with rainbow trout possible.
Cross Cr.	Limited by stream size.	USFS	Public, Trail	Hybridization with rainbow trout.	
Deadhorse Cr., Upper	Steep rocky stream.	USFS	Public, Trail	Hybridization with rainbow trout.	
Dry Wolf Cr.	Upper reaches good habitat. Lower reaches overwidened due to flooding and channel work. Localized grazing impacts.	USFS	Public	Rhoda Lake in headwaters has Yellowstone cutthroat trout, which are no longer stocked.	Extremely heavy fishing pressure at campground. Local people would like stocking program. Stocking of rainbow trout halted in 1994.
Elk Cr.	Very small stream with limited habitat, some road impacts.	USFS	Public	Competition with brook trout.	
Harrison Cr.	Excellent in pristine upper reaches, only fair in lower reaches where there are grazing impacts.	USFS, Private	Public	Hybridization with rainbow trout.	Most of drainage in Wilderness Study Area
Judith River, M. Fk.	Major road impacts.	USFS, Private	Public		Few WCT. Primarily rainbow trout, in this reach.
Judith River, S. Fk, Lower	Impacts from roads and grazing.	USFS and Private	Public	Very silty stream	Mostly rainbow trout below Dry Pole Cr. Brook trout are found in very low numbers.

Table 36 Continued. Issues for WCT streams in the Judith drainage.

Stream	Habitat quality	Land ownership	Access	Major concerns	Comments
Judith River, S. Fk., Upper	Grazing impacts but good pools and large woody debris in some reaches.	USFS	Public	Very silty stream No protection from rainbow trout introgression.	
Placer Cr.	Poor habitat. Irrigation run-off forms several channels.	USFS/Private	Public	Competition with brook trout. Poor habitat due to irrigation. Limited reach length	This stream needs work to improve habitat and prevent access from hybrid Dry Wolf WCT.
Running Wolf Cr., N. Fk.	Few pools. Small stream reach. Road impacts. Vulnerable to extinction during drought.	USFS	Public	Isolated, tiny stream. Possible encroachment by brook trout during floods.	Hand construction of pools in 1999.
Russian Cr., Lower	Good habitat, some grazing impacts.	USFS	Public	Hybridization with rainbow trout.	Few brook trout. Brook trout have access but are found in very low numbers.
Russian Cr., Upper	Good habitat, some grazing impacts.	USFS	Public	Limited habitat	
Snow Cr.	Very limited habitat due to small stream size.	USFS	Public		May be same as hybrid Dry Wolf population.
Spring Cr., E. Fk.	Good habitat	USFS	Private via trail. Public via very long trail.	No immediate threats.	Identified in 1999
Weatherwax Cr.	Excellent, mostly pristine, some grazing.	USFS	Public via trail.	Additional rainbow trout hybridization.	Most of drainage is in Wilderness Study Area
Yogo Cr.	Impacts from roads, grazing and mining.	USFS, Private	Public	Additional rainbow trout introgression, competition with brook trout.	Remnant pure population may exist in headwaters.

Table 37. Recovery actions completed in the Judith drainage.

Action	Stream	Date	Comments	Monitoring
Fencing projects	Big Hill Cr.	1996, 1999	Reduce bank trampling	Fence is maintained; restoration has not yet been evaluated.
Stream improvement & stabilization projects	Running Wolf Cr., N. Fk.	1999	Reduction in grazing pressure	
	Running Wolf Cr., N. Fk.	1999	Created several pools by hand placement of rock	Will be evaluated in 2000.
	Yogo Cr.	1999	Placement of trees to protect banks from stock trampling.	Will be evaluated in 2000.
Brook trout removal (electrofishing)	Placer Cr.	1997 & 1999	Ongoing	

Table 38. Fishless headwater reaches in Judith drainage

Introduction Site						Potential donor population characteristics		
				Survey information				
Stream	**Barrier quality/ type**	**Fish species present**	**Length (mi)**	**Amphibian**	**Insect**	**Stream**	**Genetics**	**Disease**
Cross Cr.	3 foot waterfall	None (surveyed 1997)	1.0	No survey	No survey	Not identified		
Stiner Cr.	Waterfall	None	Limited (likely too small)	No survey	No survey	Not identified		

The Musselshell Drainage
(Including Box Elder and Flatwillow Drainages)

Only two streams in the Musselshell are known to harbor pure WCT, Half Moon Canyon and Collar Gulch (Figure 13, Table 39). Both of these streams are located in the Flatwillow drainage but Collar Gulch is in the Box Elder drainage, which is a tributary to Flatwillow Creek. WCT is the only fish species in both streams. The Half Moon population is a thriving population in about 5 miles of stream and likely contains 2500 WCT. The Collar Gulch population with only 2.5 miles of habitat is at extreme risk of extinction due to short habitat length and heavy metal contamination (Table 40). Both Half Moon and Collar Gulch have dewatered areas downstream that create barriers from non-native trout. During extremely wet years, Half Moon Canyon has a downstream connection to the North Fork of Flatwillow Creek, which has a healthy brook trout population. Rainbow trout also have access to this reach.

Other trout streams in the Musselshell drainage contain brook trout, brown trout, rainbow trout, rainbow/cutthroat hybrids and Yellowstone cutthroat trout. Since it is doubtful that the Upper Musselshell is part of the native range of WCT (Castle News, 1888, Shepard et al. 1997b) limited survey work has been completed. Forest Lake, on Cottonwood Creek contains a hybrid population of WCT and Yellowstone cutthroat trout. East Fork Haymaker Creek contains pure Yellowstone cutthroat trout (Appendix A).

Completed Work: Extensive field survey work has been completed on both Half Moon and Collar Gulch (e.g. Shepard et al. 1998, Shepard et al. 1996, Appendix B). Grazing pressure has been reduced and a grazing exclosure built on Half Moon Canyon (Table 41).

Future Work: A barrier site should be investigated downstream from the WCT population in Half Moon Canyon to insure that brook trout or rainbow trout do not reach the WCT habitat. Fish surveys should be completed on more streams in the Upper Musselshell. Barrier falls may provide good places to replicate populations of genetically pure WCT or could be preserved as fishless reaches. For example, USFS surveys in 1996 found fishless reaches in the headwaters of Lebo Creek and Big Elk Creek with "plenty of water and habitat" for WCT (Table 42). These may be good areas to replicate the two existing Musselshell populations. If additional fishless areas are found they could be used as refugia for WCT populations in other drainages if needed. However, effects on existing grazing permits and the uncertainty over current and future status of introduced WCT drifting downstream onto private ranches are likely to be public issues; it is possible that a Candidate Conservation Agreement with the USFWS, USFS, MFWP and affected private landowners could resolve these concerns. It is unlikely that mine drainage in Collar Gulch will be cleaned up. The most feasible action to preserve the Collar Creek population is replication elsewhere.

Possibilities for Connected Habitat: There are no known possibilities to create large contiguous WCT habitat in the Musselshell drainage.

Figure 13. WCT distribution in the Musselshell River Drainage

Table 39. Characteristics of WCT populations, that are at least 90% pure, in the Musselshell drainage.

Water (reach)	Security from future non-native trout invasion	Barrier type	Other trout species present	Length of WCT habitat (mi)	WCT genetic purity from allozyme or PCR[1]		
					%	Hybrid	Year (last tested)
Half Moon	Medium	Dewatered	None	5	100		1994
Collar Gulch	Excellent	Dewatered	None	2.5	100		1981

Some sample sizes are very small. Detailed genetic sampling data can be found in Appendix A.

Table 40. Issues for WCT streams in the Musselshell drainage.

Stream	Habitat quality	Land ownership	Access	Major concerns	Comments
Collar Gulch	Short habitat length, few pools, Upstream mine drainage contamination and downstream dewatering limit habitat.	BLM	Public	Pollutants, Limited Habitat	Very limited habitat. High risk of stochastic extinction.
Half Moon Canyon	Excellent habitat, Some grazing degradation.	USFS	Private and public	Possible encroachment of non-native trout during high flows.	Grazing causing habitat degradation in some areas.

Table 41. Recovery actions completed in the Musselshell drainage.

Action	Stream	Date	Comments	Monitoring
Fencing projects	Half Moon	1997		Annual
Grazing management	Half Moon	1997	Reduction in AUMs	

Table 42. Fishless headwater reaches in the Musselshell drainage.

Introduction site						Potential donor population characteristics		
Stream (T, R, Sec)	Barrier quality/ type	Fish species present	Length (mi)	Survey information				
				Amphibian	Insect	Stream	Genetics	Disease
Blacktail Cr. (5N 11E 1)	Waterfall	None	1-2	No surveys	No surveys	Collar Gulch Half Moon Canyon	100%, N=16 100%, N=25	No No
Lebo Fork (6N 12E 32)	Waterfall	None	3-5	No surveys	No surveys	Same as Blacktail		
Big Elk Cr., M. F. (6 N 12E 31)	Waterfall	None	2-3	No surveys	No surveys	Same as Blacktail		

The Saskatchewan Drainage

The Saskatchewan is not part of the Missouri drainage and occupies the northwest corner of northcentral Montana, mostly in Glacier National Park. WCT are thought to have gained access to the Saskatchewan as they did to the Missouri, from the Columbia during the last glacial age. Apparently competition with native lake trout resulted in WCT historically being limited to the extreme headwaters (USFWS 1999). This drainage has not been well surveyed and only a few isolated stream reaches are thought to have WCT. Pure WCT were found in Wild Creek, a tributary to the St. Mary in 1999 (Robbin Wagner, Fisheries Biologist, US Fish and Wildlife Service, Lewistown, personal communications).

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Appendices available upon request